



LESSONS LEARNED IN PWB PROCUREMENT

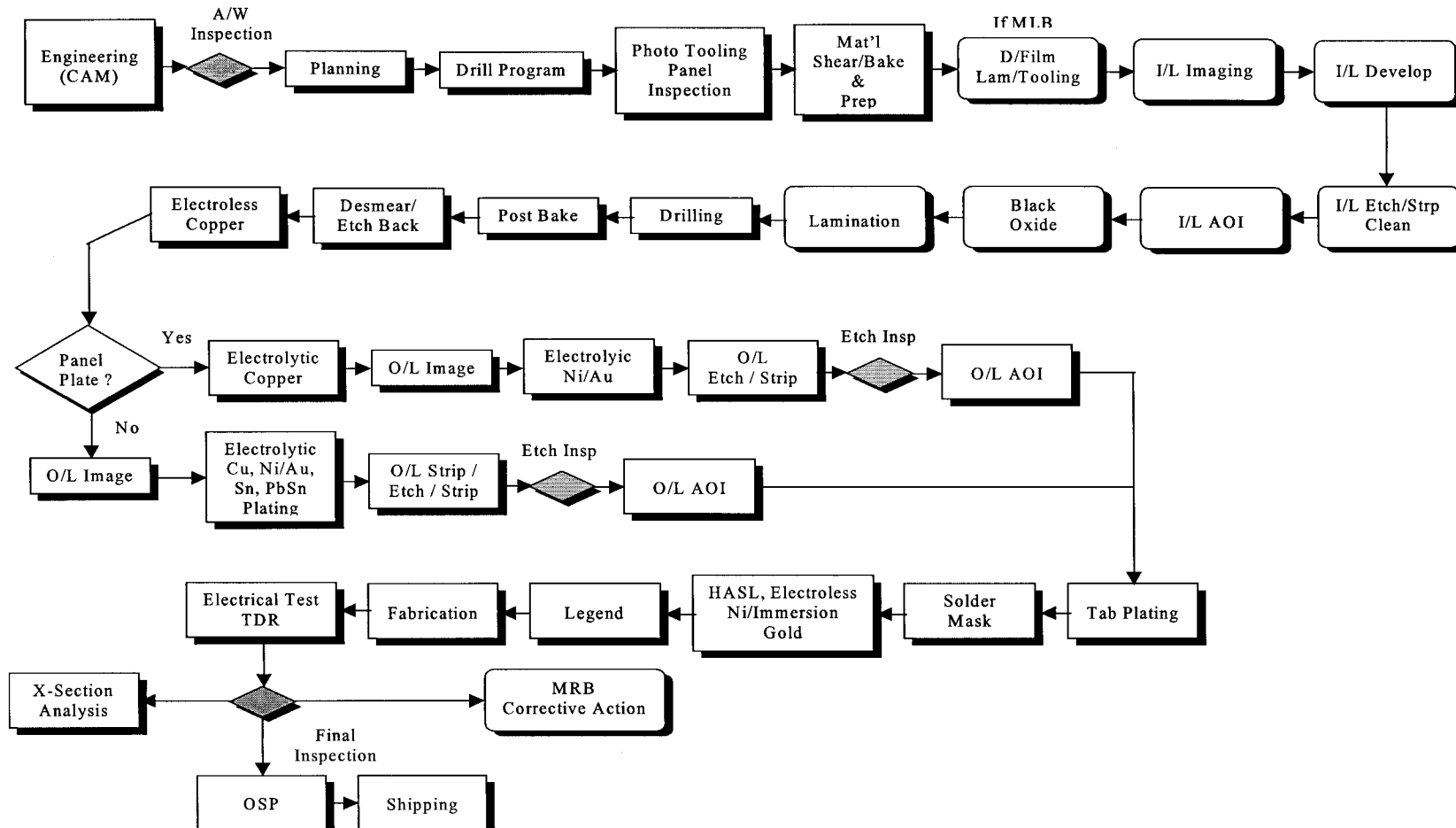
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PWB FABRICATION

- **Although They Look Relatively Simple, PWBs ARE Complex Products**
- **To Produce Them, 100s of Distinct Manufacturing Steps Are Necessary**
- **REMEMBER: Because They Are Complex Products, Plenty of Things Can Go Wrong**

PCB Fabrication Process Flow



SPECIFIC ISSUES

- **Status of Mil-Specs Creates Confusion**
- **IPC Docs Often Aimed More at Commercial Best Practices**
- **Rapidly Emerging Technologies**
- **Build Up Relation of Trust with Your Vendors**
- **Design For Producibility (DFP)**

MIL-SPECS

- **Some Are Still with Us**
- **Some Are Being Phased Out**
- **Examples:**
 - **Mil-P-55110 Now a QA Standard Only**
 - **Mil-P-13949 Already Phased Out**
- **Consequence: Procurers of High Rel PWBs Driven Towards Industry Specs**

IPC SPECS

- **IPC Specs Are Becoming De Facto Standards for PWBs**
- **IPC Specs Are Arrived at by Committee Consensus**
 - **Therefore, Should but May Not Represent BCP (Best Commercial Practice)**
- **IPC Class 3 Must Be Used with Caution**
 - **Therefore, Docs Must Be Tailored before Adoption**

TAILORED DOCUMENTS

- **JPL Has a Document Dedicated to Flight Hardware (H/W) Design and Fabrication**
 - **D-8208, Spacecraft Design and Fabrication Requirements for Electronic Packaging and Cabling**
- **D-8208 Calls Out the Relevant IPC Docs with Specific Exceptions (“Tailoring”) to Meet JPL’s Unique Needs**

PROCUREMENT DOCUMENT

- **To Meet the Requirements of ISO-9001 (JPL Became Certified in April 1999), a Document Dedicated to Procurement Issues Was Also Created**
 - **Title: PWBs, Fabrication and Acquisition of**
- **This Document Covers Some Specific Design Issues and Procurement Issues**

EMERGING TECHNOLOGIES

- **Several Technologies Are Rapidly Emerging that Will Have a Large Impact on PWB Fabrication**
 - **MicroBGAs and CSPs Will Create the Need for Microvias and More Complex Routing**
- **Green Technology**
 - **Non-lead Solder**
 - **Non-brominated PWBs**

VENDOR SELECTION

- **There are Lots of Board Shops, Choose Carefully**
- **Send a Dedicated Survey Team to a Potential Vendor**
- **Make Certain that the Vendor's Shop Fits YOUR Needs (i.e., Know Your Vendor)**
 - **E.G., Not a Good Idea to Pick a Low Mix, High Volume Shop**

VENDOR SELECTION (CONT.)

- **Create an Approved Vendor List (AVL)**
- **THEN Form a Close Working Relationship with Your Vendors**
 - **Make Sure They Remember You**
 - **Make Sure They Pay Attention to Your Order and that It Doesn't "Get Lost in the Shuffle"**

PRODUCIBILITY

- **Technically Challenging Issues Facing PWB Procurement**
- **All Designers Must Be Aware of Critical Producibility Issues, i.e., Design For Producibility (DFP)**
- **Important to Set Forth a Set of DFP Guidelines (Links back to the Documentation)**
- **Plan Ahead to Avoid a Rush Job**

SOME SPECIFIC PRODUCIBILITY ISSUES

- **The Following Are Particularly Sensitive to DFP.**
 - **Make sure that the Aspect Ratio (AR) is no greater than 8:1.**
 - **Line widths/line traces should be no less than 5 mil.**
 - **If the board is a multilayer, make sure that the constuction is symmetrical.**
- **NOTE: AR = the ratio of the board thickness to the minimum drilled hole diameter. If the minimum drilled hole diameter is 0.016" and the board thickness is 0.125", the AR = 8:1 (app.).**

PLANNING

- **The Project Engineer Should Have Good Planning Skills**
- **Building Complex Flight MLBs Is Never an Easy Task**
- **Even a Good Board Shop Experiences Problems Some of the Time**
- **So Good Planning Is Required to Avoid a Rush Job**



THE OBFUSCATED DESIGNER

The designer bent across his board;
Wonderful things in his head were stored.
And he said as he rubbed his sweating brow,
“I can make this board tough to produce-but how?
If this edge here were only straight,
I’m sure the board would work first rate.
But it’d be too easy to drill and route,
It’d never make the fabricators shout.
I’d better make this whole part thick,
Trying to drill it will make them sick.
Regular sized holes I could put in,
But really tiny ones would make ‘em mad as sin
Because they’d be hard to drill and hard to plate;
Let me see if I can make it hard to laminate.
If I greatly increase the layer count there,
They’ll scream and cry and pull their hair.
Now this board can’t be made, I’ve tried my best,
For it can’t be drilled and it can’t be pressed;
It can’t be routed and it can’t be plated;
In fact the design will be exceedingly hated.”
He got so excited that he nearly retched;
“Success is mine,” he shouted, “ it can’t even be etched!”

SUMMARY

- **Create a Document Covering the Points that Should Be Adhered to for Procurement**
- **Clarify What Specs Designers Should Be Designing to**
- **The PWB Procurement Specialist MUST Work Closely with Designers, Project Engineers, the Board Shops, and Procurement**
- **IN SUMMARY: Communicate, Communicate, Communicate**